REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Convert to Military Drawing format. Add vendor CAGE 27014 for device type 01.	87-01-09	N A Hauck
B	Add case 2 for approved source 27014. Add one approved source 01295 for cases E and 2.	87-08-25	N A Hauck
C	Delete vendor CAGE 18714. Technical and editorial changes throughout.	91-11-05	M.A.Frye

REV																			
SHEET																			
REV																			
SHEET																			

REV STATUS OF SHEETS																
REV	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14		

Defense Electronics Supply Center Dayton, Ohio

Original date of drawing:

29 January 1986

AMSC N/A

PREPARED BY
Jeffery Tunstall

CHECKED BY
D A Di Cenzo

APPROVED BY
N A Hauck

SIZE	CODE IDENT. NO.
A	**67268**

REVISION LEVEL
C

MILITARY DRAWING

This drawing is available for use by all Departments and Agencies of the Department of Defense

TITLE: MICROCIRCUITS, DIGITAL, HIGH-SPEED CMOS DUAL BINARY COUNTER, MONOLITHIC SILICON

DWG NO.
86009

SHEET 1 OF 14

5962-E083

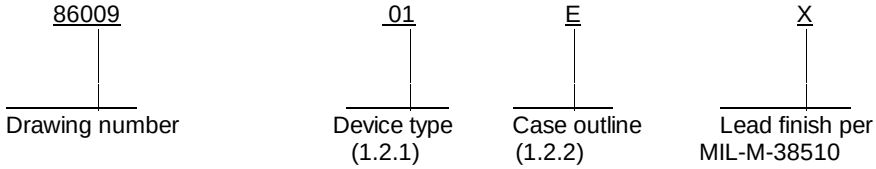
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

DESC FORM 193
MAY 86

1. SCOPE

1.1 Scope. This drawing describes device requirements for class B microcircuits in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices".

1.2 Part or Identifying Number (PIN). The complete PIN shall be as shown in the following example:



1.2.1 Device type(s). The device type(s) shall identify the circuit function as follows:

Device type	Generic number	Circuit
01	54HC390	Dual binary counter with divide by 2 and divide by 5 sections

1.2.2 Case outlines. The case outlines shall be as designated in appendix C of MIL-M-38510, and as follows:

Outline letter	Case outline
E	D-2 (16-lead, .840" x .310" x .200"), dual-in-line package
2	C-2 (20-terminal, .358" x .358" x .100"), square chip carrier package

1.3 Absolute maximum ratings. 1/

Supply voltage range	-0.5 V dc to +7.0 V dc
DC input voltage	-0.5 V dc to V_{CC} ±0.5 V dc
DC output voltage	-0.5 V dc to V_{CC} ±0.5 V dc
Clamp diode current	±20 mA
DC output current (per pin)	±25 mA
DC V_{CC} or GND current (per pin)	±50 mA
Storage temperature range	-65°C to +150°C
Maximum power dissipation (P_D)	-500 mW 2/
Lead temperature (soldering, 10 seconds)	+260°C
Thermal resistance, junction-to-case (θ_{JC}): 2/	See MIL-M-38510, appendix C
Junction temperature (T_J)	+175°C

1.4 Recommended operating conditions.

Supply voltage (V_{CC})	+2.0 V dc minimum to +6.0 V dc maximum
Case operating temperature range (T_C)	-55°C to +125°C
Input voltage range (V_{IN})	0.0 V dc to V_{CC}
Output voltage range (V_{IN})	0.0 V dc to V_{CC}

1/ Unless otherwise specified, all voltages are referenced to ground.
2/ For T_C = +100°C to +125°C, derate linearly at 12 mW/°C.

Input rise or fall time (t_r, t_f):
V_{CC} = 2.0 V ..... 0 to 500 ns
V_{CC} = 4.5 V ..... 0 to 500 ns
V_{CC} = 6.0 V ..... 0 to 400 ns
Minimum recovery time, reset (t_{rec}):
T_C = +25°C,
V_{CC} = 2.0 V ..... 50 ns
V_{CC} = 4.5 V ..... 10 ns
V_{CC} = 6.0 V ..... 9 ns
T_C = -55°C/+125°C,
V_{CC} = 2.0 V ..... 75 ns
V_{CC} = 4.5 V ..... 15 ns
V_{CC} = 6.0 V ..... 13 ns
Minimum width of clock or reset pulse (t_w):
T_C = +25°C,
V_{CC} = 2.0 V ..... 85 ns
V_{CC} = 4.5 V ..... 17 ns
V_{CC} = 6.0 V ..... 14 ns
T_C = -55°C/+125°C,
V_{CC} = 2.0 V ..... 130 ns
V_{CC} = 4.5 V ..... 26 ns
V_{CC} = 6.0 V ..... 22 ns
Maximum clock frequency (f_{MAX}):
T_C = +25°C,
V_{CC} = 2.0 V ..... 5.4 MHz
V_{CC} = 4.5 V ..... 27 MHz
V_{CC} = 6.0 V ..... 32 MHz
T_C = -55°C/+125°C,
V_{CC} = 2.0 V ..... 3.6 MHz
V_{CC} = 4.5 V ..... 18 MHz
V_{CC} = 6.0 V ..... 21 MHz

2. APPLICABLE DOCUMENTS

2.1 Government specification, standard, and bulletin. Unless otherwise specified, the following specification, standard, and bulletin of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this drawing to the extent specified herein.

SPECIFICATION

MILITARY

MIL-M-38510 - Microcircuits, General Specification for.

STANDARD

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

BULLETIN

MILITARY

MIL-BUL-103 - List of Standardized Military Drawings (SMD's).
(Copies of the specification, standard, and bulletin required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing shall take precedence.

3. REQUIREMENTS

3.1 Item requirements. The individual item requirements shall be in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices" and as specified herein.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

3.2.1 Terminal connections. The terminal connections shall be as specified on figure 1.

3.2.2 Logic diagram. The logic diagram shall be as specified on figure 2.

3.2.3 Truth tables and counting sequence diagram. The truth tables and counting sequence diagram shall be as specified on figures 3.

3.2.4 Case outline(s). The case outline(s) shall be in accordance with 1.2.2 herein.

3.3 Electrical performance characteristics. Unless otherwise specified, the electrical performance characteristics are as specified in table I and apply over the full recommended case operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table I.

3.5 Marking. Marking shall be in accordance with MIL-STD-883 (see 3.1 herein). The part shall be marked with the part number listed in 1.2 herein. In addition, the manufacturer's part number may also be marked as listed in MIL-BUL-103 (see 6.6 herein).

3.6 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in MIL-BUL-103 (see 6.6 herein). The certificate of compliance submitted to DESC-ECS prior to listing as an approved source of supply affirm state that the manufacturer's product meets the requirements of MIL-STD-883 (see 3.1 herein) and the requirements herein.

3.7 Certificate of conformance. A certificate of conformance as required in MIL-STD-883 (see 3.1 herein) shall be provided with each lot of microcircuits delivered to this drawing.

3.8 Notification of change. Notification of change to DESC-ECS shall be required in accordance with MIL-STD-883 (see 3.1 herein).

3.9 Verification and review. DESC, DESC's agent, and the acquiring activity retain the option to review the manufacturer's facility and applicable required documentation. Offshore documentation shall be made available onshore at the option of the reviewer.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +125°C$ unless otherwise specified		Group A subgroups	Limits		Unit
					Min	Max	
High level output voltage	V_{OH}	$V_{IN} = V_{IH}$ min or V_{IL} max; $\|IO\| = 20$ µA	$V_{CC} = 2.0$ V	1, 2, 3	1.9		V
			$V_{CC} = 4.5$ V		4.4		
			$V_{CC} = 6.0$ V		5.9		
		$V_{IN} = V_{IH}$ min or V_{IL} max; $\|I_O\| = 4.0$ mA	$V_{CC} = 4.5$ V		3.7		
		$V_{IN} = V_{IH}$ min or V_{IL} max; $\|I_O\| = 5.2$ mA	$V_{CC} = 6.0$ V		5.2		
Low level output voltage	V_{OL}	$V_{IN} = V_{IH}$ min or V_{IL} max; $\|I_O\| = 20$ µA	$V_{CC} = 2.0$ V	1, 2, 3		0.1	V
			$V_{CC} = 4.5$ V			0.1	
			$V_{CC} = 6.0$ V			0.1	
		$V_{IN} = V_{IH}$ min or V_{IL} max; $\|I_O\| = 4.0$ mA	$V_{CC} = 4.5$ V			0.4	
		$V_{IN} = V_{IH}$ min or V_{IL} max; $\|I_O\| = 5.2$ mA	$V_{CC} = 6.0$ V			0.4	
High level input voltage	V_{IH}	2/	$V_{CC} = 2.0$ V	1, 2, 3	1.5		V
			$V_{CC} = 4.5$ V		3.15		
			$V_{CC} = 6.0$ V		4.2		

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +125°C$ unless otherwise specified		Group A subgroups	Limits		Unit
					Min	Max	
Low level input voltage	V_{IL}	2/	V_{CC} = 2.0 V	1, 2, 3		0.3	V
			V_{CC} = 4.5 V			0.9	
			V_{CC} = 6.0 V			1.2	
Input capacitance	C_{IN}	V_{IN} = 0 V; See 4.3.1c		4		10	pF
Quiescent current	I_{CC}	V_{CC} = 6.0 V; V_{IN} = V_{CC} or GND		1, 2, 3		160	µA
Input leakage current	I_{IN}	V_{CC} = 6.0 V; V_{IN} = V_{CC} or GND		1, 2, 3		±1	µA
Functional tests		See 4.3.1d		7, 8			
Propagation delay time, CLOCK An to QAn 3/	t_{PHL1}, t_{PLH1}	C_L = 50 pF; See figure 4	V_{CC} = 2.0 V	9		145	ns
				10, 11		220	
			V_{CC} = 4.5 V	9		29	
				10, 11		44	
			V_{CC} = 6.0 V	9		25	
				10, 11		38	
Propagation delay time, CLOCK Bn to QBn 3/	t_{PHL2}, t_{PLH2}	C_L = 50 pF; See figure 4	V_{CC} = 2.0 V	9		155	ns
				10, 11		235	
			V_{CC} = 4.5 V	9		31	
				10, 11		47	
			V_{CC} = 6.0 V	9		26	
				10, 11		40	

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +125°C$ unless otherwise specified		Group A subgroups	Limits		Unit
					Min	Max	
Propagation delay time, CLOCK Bn to QCn 3/	t_{PHL3}, t_{PLH3}	C_L = 50 pF; See figure 4	V_{CC} = 2.0 V	9		210	ns
				10, 11		315	
			V_{CC} = 4.5 V	9		42	
				10, 11		63	
			V_{CC} = 6.0 V	9		36	
				10, 11		54	
Propagation delay time, CLOCK Bn to QDn 3/	t_{PHL4}, t_{PLH4}	C_L = 50 pF; See figure 4	V_{CC} = 2.0 V	9		155	ns
				10, 11		235	
			V_{CC} = 4.5 V	9		31	
				10, 11		47	
			V_{CC} = 6.0 V	9		26	
				10, 11		40	
Propagation delay time, RESET n to any Qn 3/	t_{PHL5}	C_L = 50 pF; See figure 4	V_{CC} = 2.0 V	9		165	ns
				10, 11		250	
			V_{CC} = 4.5 V	9		33	
				10, 11		50	
			V_{CC} = 6.0 V	9		28	
				10, 11		43	
Transition time 4/	t_{TLH}, t_{THL}	C_L = 50 pF; See figure 4	V_{CC} = 2.0 V	9		75	ns
				10, 11		110	
			V_{CC} = 4.5 V	9		15	
				10, 11		22	
			V_{CC} = 6.0 V	9		13	
				10, 11		19	

See footnotes at the end of table.

TABLE I. Electrical performance characteristics - Continued.

1/ For a power supply of 5.0 V ±10% the worst case output voltages (V_{OH} and V_{OL}) occur for HC at 4.5 V. Thus the 4.5 Values should be used when designing with this supply. Worst case V_{IH} and V_{IL} occur at V_{CC} = 5.5 V and 4.5 V respectively. (The V_{IH} value at 5.5 V is 3.85 V).
The worst case leakage current (I_{IN}, I_{CC}, and I_{OZ}) occur for CMOS at the higher voltage and so the 6.0 V values should be used. Power dissipation capacitance (C_{PD}), typically 40 pF, determines the no load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$, and the no load dynamic current consumption, $I_S = C_{PD} V_{CC} f + I_{CC}$.
2/ V_{IH} and V_{IL} tests are not required if applied as forcing function for V_{OH} and V_{OL}.
3/ AC testing at V_{CC} = 2.0 V and V_{CC} = 6.0 V shall be guaranteed, if not tested, to the specified parameters.
4/ Transition time, (t_{TLH}, t_{THL}), if not tested, shall be guaranteed to the specified parameters.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with section 4 of MIL-M-38510 to the extent specified in MIL-STD-883 (see 3.1 herein).

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to quality conformance inspection. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D using the circuit submitted with the certificate of compliance (see 3.6 herein).

(2) T_A = +125°C, minimum.

b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 Quality conformance inspection. Quality conformance inspection shall be in accordance with method 5005 of MIL-STD-883 including groups A, B, C, and D inspections. The following additional criteria shall apply.

4.3.1 Group A inspection.

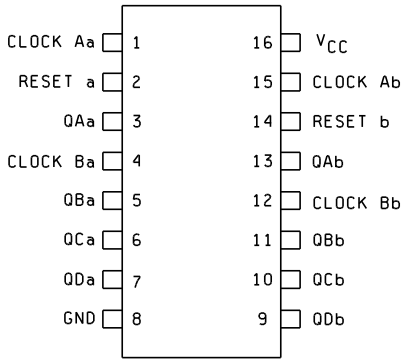
a. Tests shall be as specified in table II herein.

b. Subgroups 5 and 6 in table I, method 5005 of MIL-STD-883 shall be omitted.

c. Subgroup 4 (C_{IN} measurement) shall be measured only for the initial test and after process or design changes which may affect input capacitance. Capacitance shall be measured between the designated terminal and GND at a frequency of 1 MHz. Test all applicable pins on five devices with zero failures.

d. Subgroup 7 tests shall verify the truth table as specified on figure 2.

Case E



Case 2

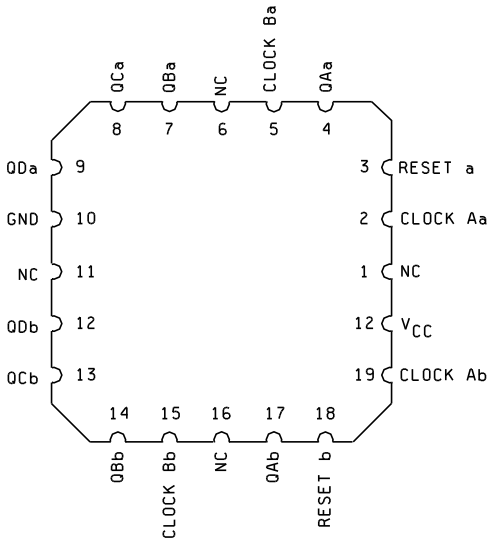


FIGURE 1. Terminal connections (top view).

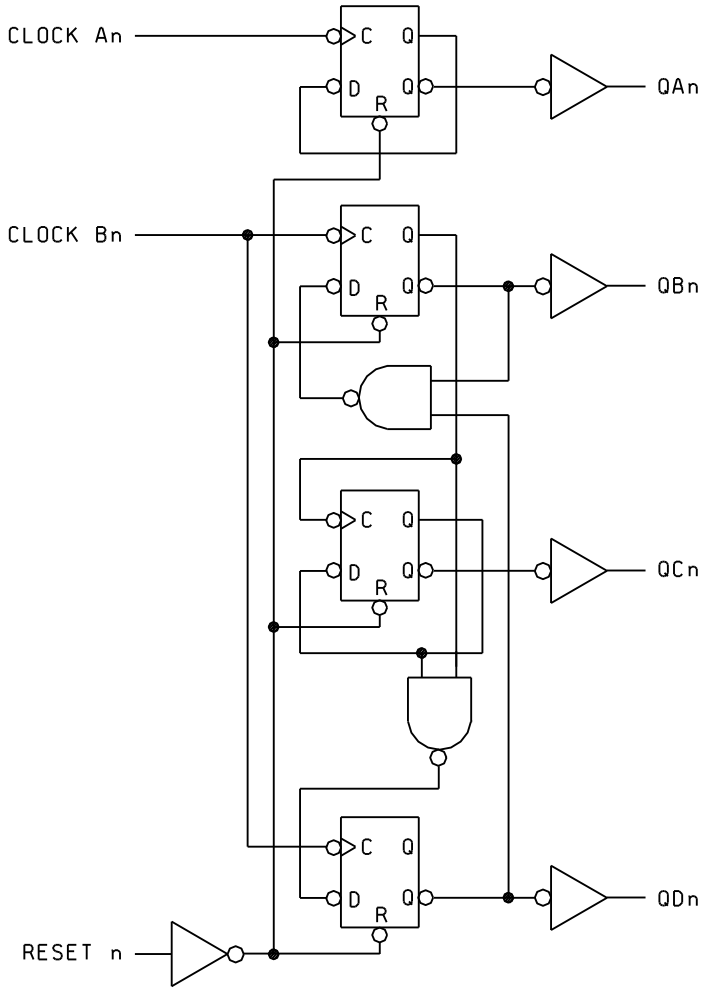
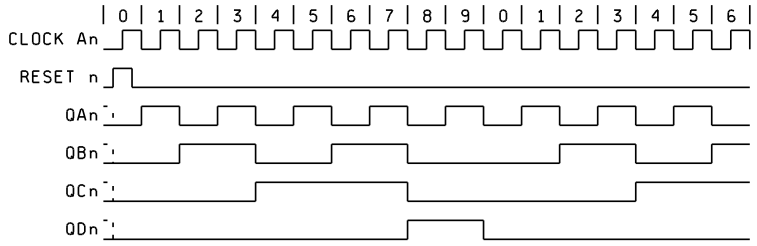


FIGURE 2. Logic diagram.



BI-QUINARY COUNT SEQUENCE**

Count	Output			
	QAn	QDn	QCn	QBn
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	H	L	L	L
6	H	L	L	H
7	H	L	H	L
8	H	L	H	H
9	H	H	L	L

** QD connected to clock A input with counter input on clock Bn.

BCD COUNT SEQUENCE*

Count	Output			
	QD	QC	QB	QA
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

* QAn connected to clock B input with counter input on clock An.

FUNCTION TABLE

CLOCK An Bn	RESET n	Action
X X	H	Reset -2 and -5
¯_ X	L	Increment -2
X ¯_	L	Increment -5

L = Low level voltage
¯_ H = High level voltage
_ = High-to-low transition of clock

FIGURE 3. Truth tables and counting sequence.

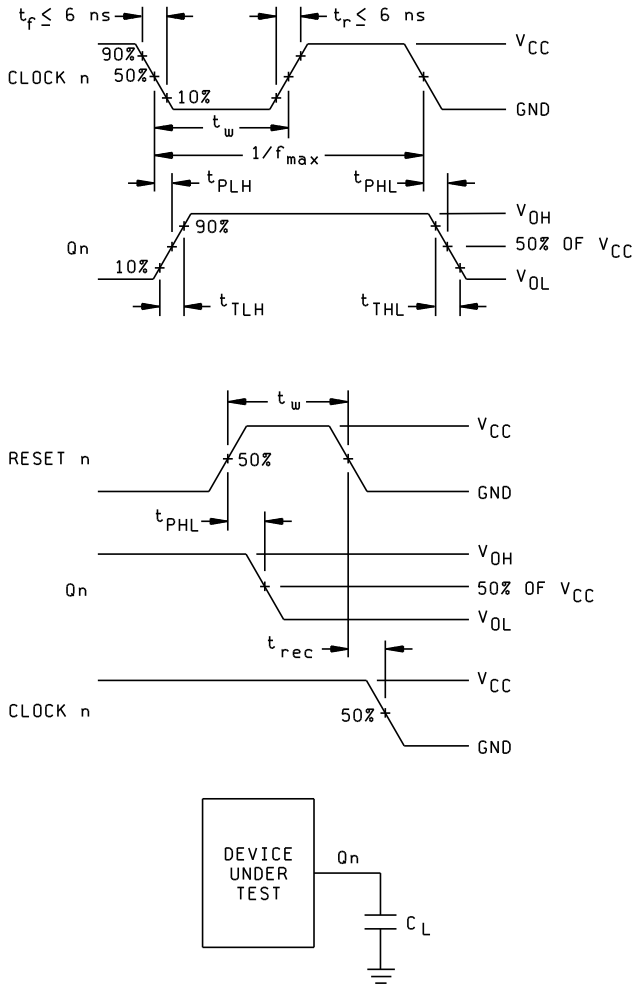


FIGURE 4. Switching waveforms.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (per method 5005, table I)
Interim electrical parameters (method 5004)	---
Final electrical test parameters (method 5004)	1*,2,3,9
Group A test requirements (method 5005)	1,2,3,7,8,9, 10**,11**
Groups C and D end-point electrical parameters (method 5005)	1,2,3

* PDA applies to subgroup 1.
** Subgroups 10 and 11, if not tested, shall be guaranteed to the specified limits in table I.

4.3.2 Groups C and D inspections.

a. End-point electrical parameters shall be as specified in table II herein.

b. Steady-state life test conditions, method 1005 of MIL-STD-883.

(1) Test condition A,B, C, or D using the circuit submitted with the certificate of compliance (see 3.6 herein).

(2) T_A = +125°C, minimum.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use when military specifications do not exist and qualified military devices that will perform the required function are not available for OEM application. When a military specification exists and the product covered by this drawing has been qualified for listing on QPL-38510, the device specified herein will be inactivated and will not be used for new design. The QPL-38510 product shall be the preferred item for all applications.

6.2 Replaceability. Replaceability is determined as follows:

a. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

b. When a QPL source is established, the device specified in this drawing will be replaced by the microcircuit identified as PIN M38510/66308.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated with the users of record for the individual documents. This coordination will be accomplished in accordance with MIL-STD-481 using DD Form 1693, Engineering Change Proposal (Short Form).

6.4 Record of users. Military and industrial users shall inform Defense Electronics Supply Center when a system application requires configuration control and the applicable SMD. DESC will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronics devices (FSC 5962) should contact DESC-ECS, telephone (513) 296-6022.

6.5 Comments. Comments on this drawing should be directed to DESC-ECS, Dayton, Ohio 45444, or telephone (513) 296-5375.

6.6 Approved sources of supply. Approved sources of supply are listed in MIL-BUL-103. The vendors listed in MIL-BUL-103 have agreed to this drawing and a certificate of compliance (see 3.6 herein) has been submitted to and accepted by DESC-ECS.

STANDARDIZED MILITARY DRAWING SOURCE APPROVAL BULLETIN

DATE: 91-11-05

Approved sources of supply for SMD 86009 are listed below for immediate acquisition only and shall be added to MIL-BUL-103 during the next revision. MIL-BUL-103 will be revised to include the addition or deletion of sources. The vendors listed below have agreed to this drawing and a certificate of compliance has been submitted to and accepted by DESC-ECS. This bulletin is superseded by the next dated revision of MIL-BUL-103.

Standardized military drawing PIN	Vendor CAGE number	Vendor similar PIN 1/	Replacement military specification PIN
8600901EX	01295 04713 27014 34371	SNJ54HC390J 54HC390/BEAJC MM54HC390J/883 CD54HC390F/3A	M38510/66308BEX
86009012X	01295 04713 27014	SNJ54HC390FK 54HC390M/B2CJC MM54HC390E/883	M38510/66308B2X

1/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.

Vendor CAGE number	Vendor name and address
01295	Texas Instruments, Incorporated P.O. Box 6448 Midland, TX 79701
04713	Motorola, Incorporated 7402 S. Price Road Tempe, AZ 85283
27014	National Semiconductor P.O. Box 58090 Santa Clara, CA 95052-8090
34371	Harris Semiconductor P.O.Box 883 Melbourne, FL 32901

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